DIP

TERMINATOR AND NIGHTSIDE IONOSPHERE OF VENUS

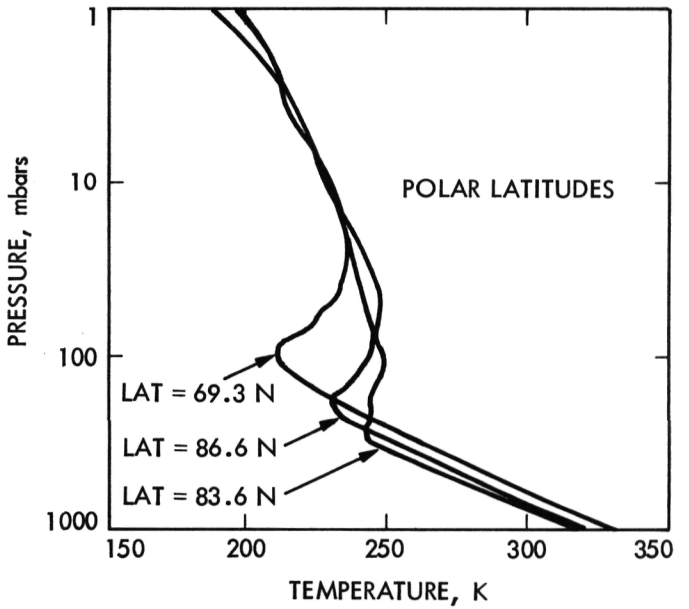
Simultaneous reception of S- and X-band radio signals from the Pioneer Venus Orbiter was used at occultation to determine the vertical structure of electron density in the planet's ionosphere.

The geometry was favorable during the first occultation season for studying the ionosphere from near the terminator, across it, and almost to the anti-solar point.

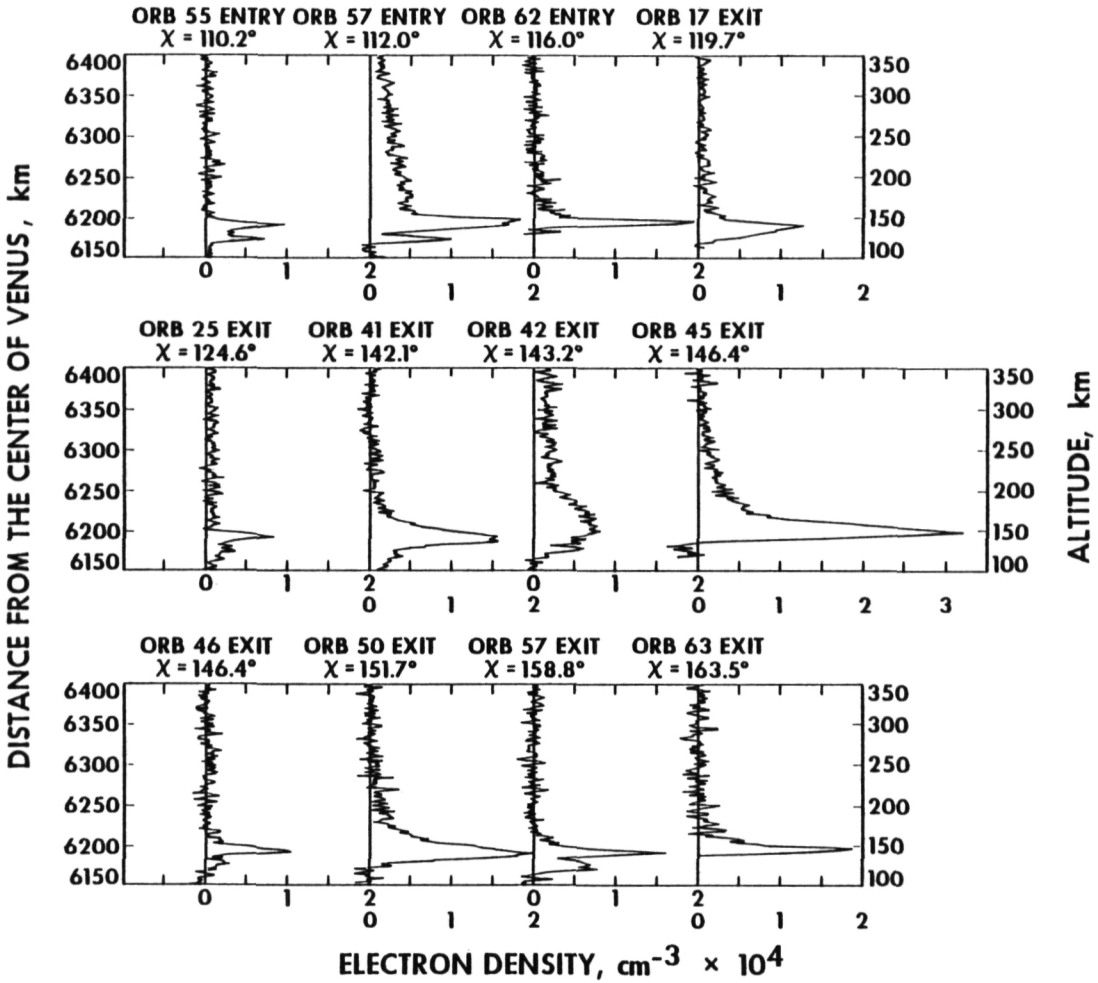
Measurements near the terminator showed an orderly decrease of the peak density from about 164,000 electrons per cubic centimeter at a solar zenith angle of 87 degrees to about 30,000 electrons per cubic centimeter at 96 deg (6 deg beyond the terminator). As the site of measurement approaches the terminator, a region of almost constant electron density develops above the main peak, beginning at an altitude of about 250 kilometers and extending up to 500 km. The height of the ionosphere varied from about 300 to about 700 km and was apparently influenced by diurnal changes in the solar wind conditions. The structure of the profiles above the main peak, showing a transition in scale height at about 170 km, is consistent with models in which the O_2^+ ion is dominant at the main peak (about 140 km), but O^+ becomes the principal ion at higher altitudes.

Beyond a solar zenith angle of about 110 deg, the "deep" nightside ionosphere begins, and no further effect of the distance from the terminator is observed. The structure and magnitude of the electron density are highly variable and show no correlation with measurements taken 24 hours earlier or later. The mean main peak electron density is 16,700 ± 7200 (standard deviation) electrons per cubic centimeter. The altitude of the main ionization peak, which is always observed, remains fairly constant at 142.2 ± 4.1 km, virtually identical to the mean peak altitude on the dayside.

The two principal mechanisms that have been mentioned in connection with explaining how the nightside ionosphere is maintained through the long Venusian night are: (1) horizontal transport of major ions, mostly O^+ and O_2^+, from the upper regions of the dayside ionosphere, followed by downward diffusion; and (2) direct impact ionization by precipitating electrons or protons. It has been suggested that the former mechanism could be responsible for the extremely variable, tenuous ionization above the peak, but that the main peak is formed by the latter mechanism.



Superimposed temperature-pressure characteristics of the Venus circumpolar atmosphere showing the decrease of the tropopause inversion magnitude and the lowering of the tropopause level from 70 degrees latitude to the polar regions.



Selected electron density profiles from nightside measurements of Venus. Both the magnitude and structure of the main peak are highly variable, possibly indicating the variability of the participating electron flux that defines the main peak ionization magnitude, and the energy distribution, which defines the vertical structure.